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Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

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U.S. Department of Commerce
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Discussions of a Model and Correlation for the ISO 9705 Room-Corner Test

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New examinations of a predictive model [1] for the ISO 9705 room-corner test have been made for materials studied by L S Fire Laboratories [2]. The ISO 9705 tests subjects a wall and ceiling mounted material to a corner ignition source of 100 kW for a duration of 10 minutes; if flashover does not occur this is followed by 300 kW for another 10 minutes. Twelve materials studied included many that would melt, drip, or distort during combustion; thus, they would not remain intact as wall and ceiling surfaces. Since the predictive model could not address these effects, they were all represented by an adjustment to the material's total available energy. In effect, the burn time (as a wall or ceiling element) was reduced to account for the material falling to the floor. Subsequent floor combustion was not included.

The materials that did not stay in place during combustion prove to be a challenge in modeling and prediction. For materials that remain in place the simulation model appears to do well in its predictions as illustrated by Figures 1 and 2 for normal and fire retarded plywood, respectively. Properties derived from Cone Calorimeter data for these materials are listed below:

	Ign. Temp.,C	Heat of Comb., kJ/g	Heat of Gasification, kJ/g
Normal Plywood	290	11.9	7.3
Retarded Plywood	480	11.2	9.3

The methodology for deriving these and other properties are described in the M. S. Thesis of Dillon [3].

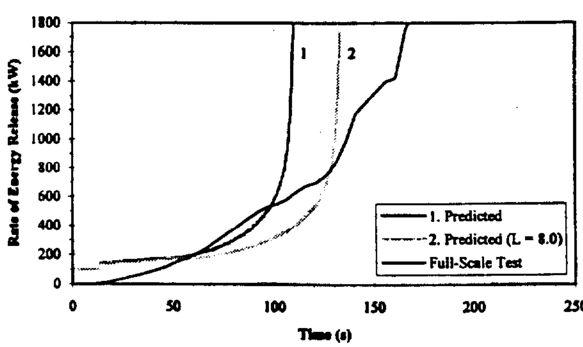

Fig. 1. Normal Plywood

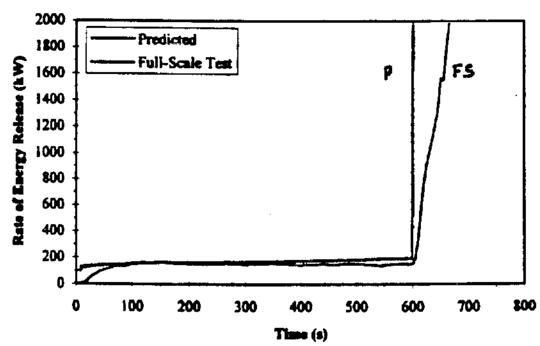

Fig. 2. Retarded Plywood

An example of the simulation prediction for a melting material is shown in Figure 3 for extruded polystyrene board. This is 40 mm thick, 30 kg/m^3. and glued to a non-combustible board in mounting. Its total available energy was measured to be 38.7 MJ/m^2 (Q"), but this had to be reduced to 15 % of its value to account for the melting depletion effect from the walls and ceiling. If we examine the results in Figure 3, we see that the original Q" value achieved the 1000 kW flashover criterion about 30 s before the test result. However, it should be noted that the test measurement of energy release rate by oxygen consumption rate appears to have a lag of about 30 s since the test results do not immediately follow the initial burner setting of 100 kW. Due to melting, the test results lead to a sudden decrease at about 100 s. Observations indicated significant melting and dripping to the floor at 85 s and ignition was observed to occur at about 20 s. A calculation with the Q" reduced to 15 % of its Cone measured value appears to follow the "second flashover" measured after 600 s. This illustration is indicative of a prediction for a material that does not remain intact, and how it might be accommodated in the model be reducing the Q" value. It suggests a need to characterize the burning time for the material while contiguous with its mounting surface so that appropriate values of Q" can be developed, and to assess the apparent secondary effect of floor burning due to dripping.

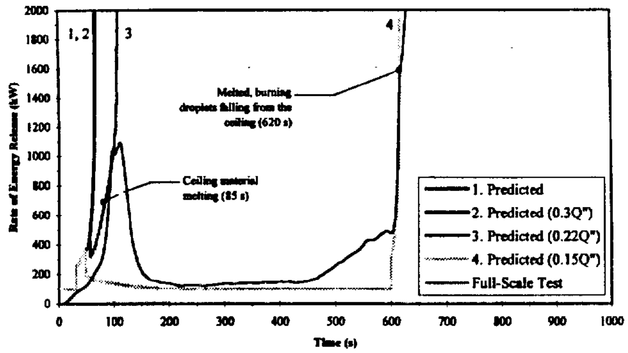

Figure 3. Extruded Polystyrene Board

An empirical correlation based solely on upward spread which appears to dominate the ISO 9705 test, was applied to the LSF data as well as 24 materials previously examined [4]. The correlation explained in Ref. [3],

$\tau_{FO} - 1$ is inversely dependent on a for $\tau_{FO} \le 1 + \tau_b$, and

$\tau_{FO} - 1 - \tau_b$ is inversely dependent on b for $\tau_{FO} \ge 1 + \tau_b$

where $\tau_{FO} = \frac{t_{FO}}{t_{ig}}$ and $\tau_b = \frac{t_b}{t_{ig}}$: t_{FO} is flashover time,

t_{ig} is ignition time computed at $30\ kW/m^2$,

t_b is burnout time computed at $60\ kW/m^2$,

$a = 0.01\dot{Q}'' - 1$, $b = a - \frac{1}{\tau_b}$, and $\dot{Q}''$ is the energy release flux (kW/m^2) at $60\ kW/m^2$.

The results for all materials in our database are shown in Figures 4 and 5 for the two time regimes.

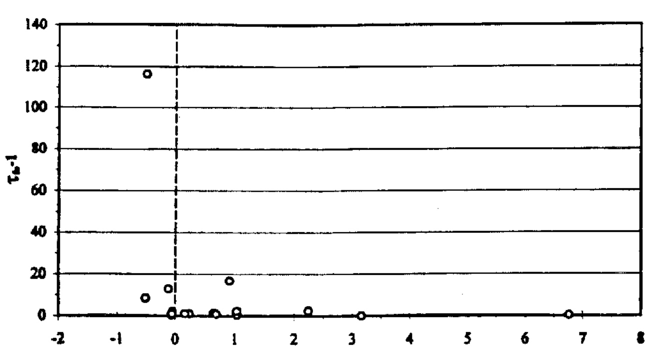

Figure 4. Correlation **a**

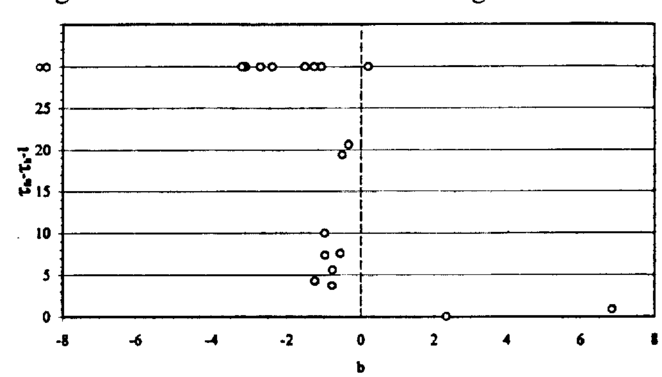

Figure 5. Correlation **b**

1. Quintiere, J. G., Fire Safety Journal, Vol. 20, No. 4, 1993.
2. Thureson, P. "Fire tests of linings according to Room/Corner Test, ISO 9705", Swedish Nat. Test. and Res. Inst. Rept. 95R22049, Jan 1996.
3. Dillon, S. E., M. S Thesis, Dept. of Fire Prot. Engrg., U. Of Maryland, August, 1998.
4. Quintiere, J. G., "Estimating Fire Growth on Compartment Interior Finish Materials", SFPE Engrg Sem., SFPE Meeting, San Francisco, CA, May 16-18, 1994.